

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE INSTALLATION GUIDELINES**

RIPARIAN FOREST BUFFER

(ac.)
CODE 391

Planning and installation of Riparian Forest Buffer (RFB) plantings shall adhere to the Natural Resources Conservation Service (NRCS) conservation practice standard "Riparian Forest Buffer," (Code 391) in the electronic Field Office Technical Guide (eFOTG).

Riparian Forest Buffers are not windbreak/shelterbelt plantings moved down to the creek. Riparian Forest Buffers are located to serve different purposes and must be designed accordingly. With slight modifications in design, Riparian Forest Buffers can be made to serve a variety of purposes while addressing the main purpose for its existence.

Material in this document will provide information needed for a successful design that meets standards

Supporting documents needed to design riparian forest buffers include:

"Expected Tree and Shrub Heights at 20 years," Section II, eFOTG.

Woodland Technical Note No. 37 – "Tree and Shrub Characteristics for Riparian or Specialty Plantings"

Woodland Technical Note No. 38 – "Tree and Shrub, Handling, Planting, and Care"

RIPARIAN FOREST BUFFER LOCATION

Riparian forest buffers are positioned on the landscape adjacent to permanent and intermittent streams and water bodies. They are strongly influenced by the additional water that is present within riparian areas. See Figure 1. This additional moisture, beyond normal precipitation for the locality, impacts the type and vigor of vegetation that can be sustained in a riparian area. Riparian areas are generally the most biologically diverse and productive landform. Riparian forests can vary in width from a narrow band near the stream edge to a fully stocked forest that encompasses the entire flood plain.

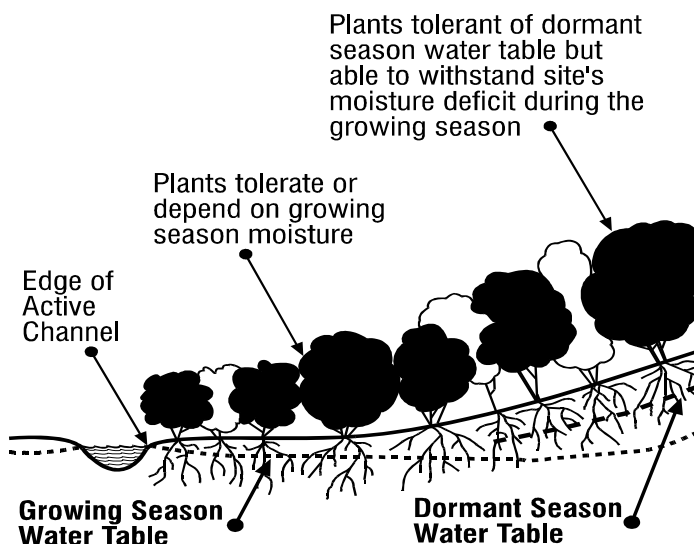


Figure 1. Plant adaptation to soil moisture.

PARTS OF A RIPARIAN FOREST BUFFER

All riparian forest buffers will consist of a Zone 1 of trees and/or shrubs that begins at the normal water line of a water body, or at the top of the stream bank; and extends a minimum distance of 15 feet, measured horizontally on a line perpendicular to the water body. See Figure 2.

Normal water level is generally the lowest point in the stream channel or water body where permanent vegetation begins to take hold on sand and gravel bars. Local experiences or on-site observations are necessary to determine normal water lines.

All buffers will also consist of a Zone 2 of trees and/or shrubs that begins at the upper end of Zone 1 and extends outward for a minimum of 20 feet. See Figure 2.

A Zone 3 of perennial herbaceous vegetation may be included, if needed, to control sediment and address concentrated flow entering Zone 2 from adjacent cropland or sparsely vegetated areas up-gradient from Zone 2. Favor native grass species that are compatible with the landowner's objectives and buffer function in Zone 3.

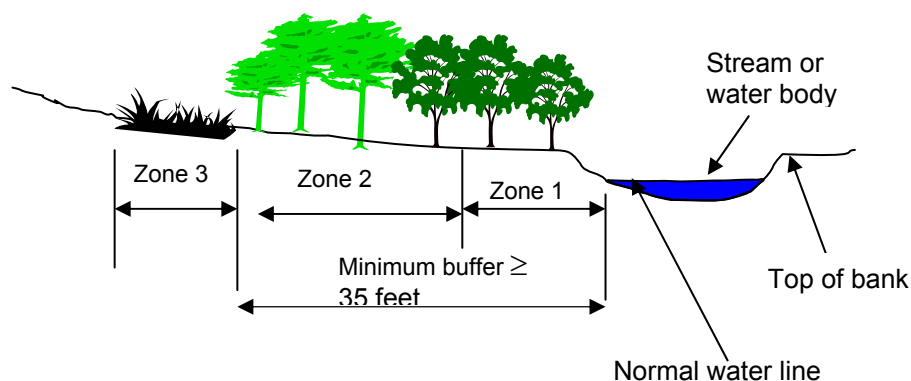


Figure 2. Parts of a riparian forest buffer.

Concentrated flow erosion up-gradient of the buffer must be controlled to assure successful function of the riparian forest buffer in filtering sediment and pollutants from adjacent land uses. See Figure 3. The addition of a grassed filter strip (Zone 3) shall be added to the riparian buffer when needed to control concentrated flow erosion and maintain sheet flow. The Filter Strip Practice Standard (Code 393A) shall be used to design Zone 3.

Where filter strips are not expected to control the concentrated flow, structural measures may be needed.

For watercourses or waterbodies with streambank or shoreline erosion, the establishment of riparian forest buffers must be done at the same time or following the installation of streambank and shoreline protection. Refer to the Streambank and Shoreline Protection Practice Standard (Code 580) for design and installation requirements.

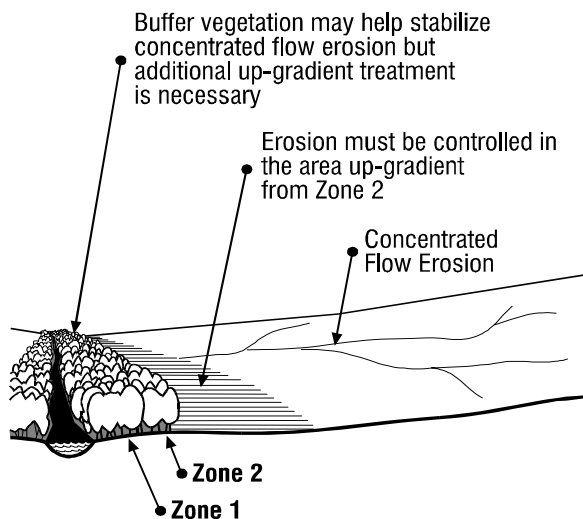


Figure 3. Control of concentrated flow erosion.

RIPARIAN BUFFER DESIGN FOR ALL PURPOSES

No trees shall be placed within the easement area of overhead transmission lines unless permission has been secured from the appropriate utility company.

Riparian Forest Buffers will not be located where they will cause snowdrifts to impact roadways or other transportation corridors. Consult the Windbreak/Shelterbelt Establishment conservation practice standard (Code 380) for guidance on set back distances.

Consider the type of human use (rural, suburban, and urban) and the aesthetic, social and safety aspects of the area to determine the vegetation selection, arrangement and management. For example, avoiding shrubs that block views and pruning lower tree branches near recreation trails allows for ease of patrolling. Refer to Woodland Technical Note No. 37 "Tree and Shrub Characteristics for Riparian or Specialty Plantings" for specific plant characteristics.

In all cases, if local units of government have established more restrictive setback distances, then the more restrictive regulations will apply.

The location, layout and density of the buffer should complement natural features.

Minimum Design Width of Zones 1 and 2 Combined

When applying these minimums, consider each side of the stream independently. If the flood plain width in the area of the riparian forest buffer varies because of a meandering stream, use an average to determine the flood plain width.

If the geomorphic flood plain is equal to or greater than 333 feet, the minimum design width of Zones 1 and 2 combined is 100 feet.

If the geomorphic flood plain is greater than 119 feet, but less than 333 feet, the minimum design width of Zones 1 and 2 combined is 30 percent of the geomorphic flood plain.

If the geomorphic flood plain is equal to or less than 118 feet, or there is no geomorphic flood plain, such as along an intermittent stream or around a water body, the minimum design width of Zones 1 and 2 combined is 35 feet.

Figure 4 illustrates examples of minimum widths for Zones 1 and 2 along watercourses and water bodies formed under different hydrologic conditions.

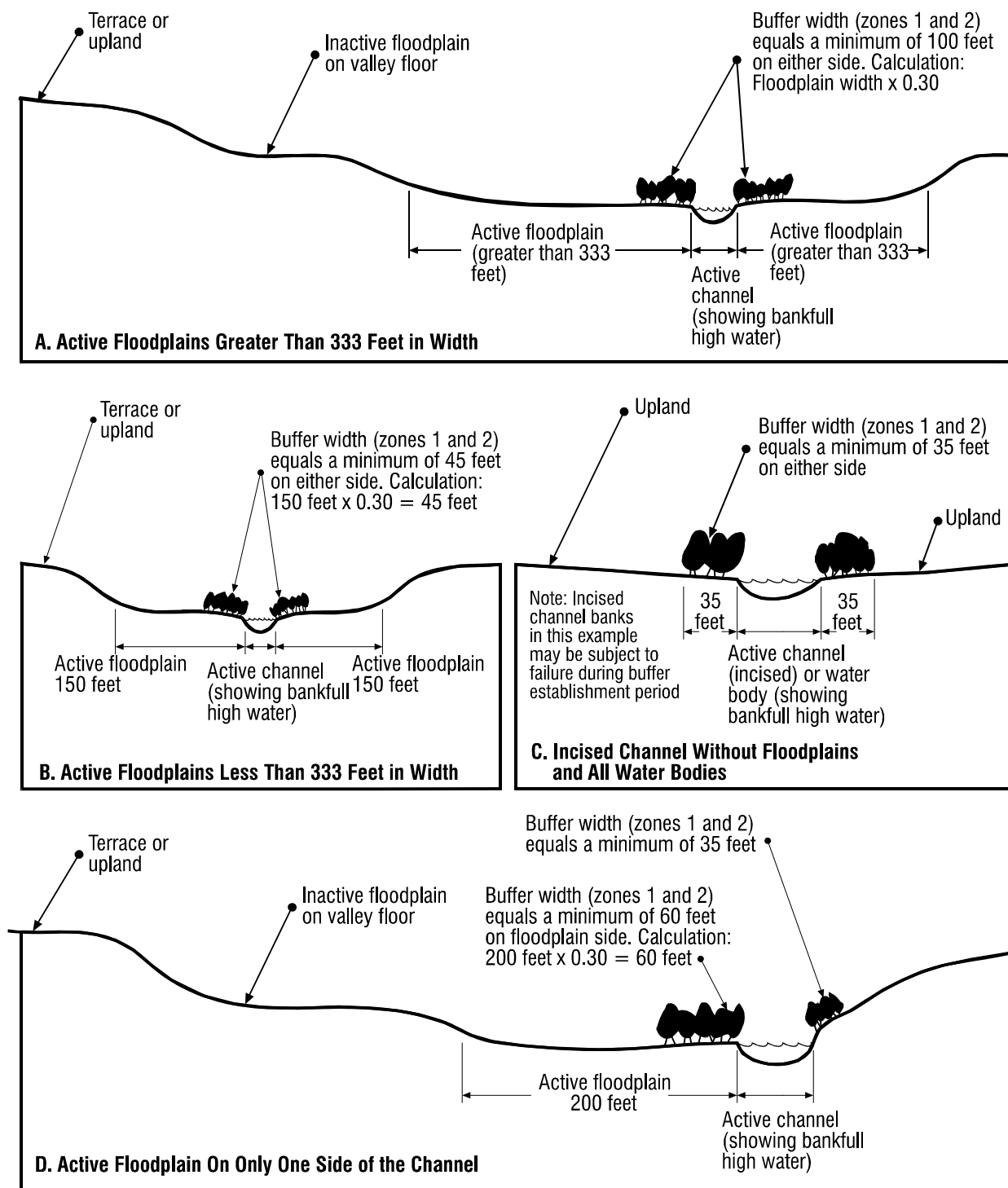


Figure 4. Examples of riparian forest buffer widths for watercourses and water bodies.

Design Density of Riparian Forest Buffers

The initial goal of a riparian forest buffer is to fully "capture" the site with a fully stocked forest planting that will quickly develop a duff layer, detritus, and rapidly growing trees with extensive root systems that will begin riparian functions as soon as possible. High initial stocking rates will minimize establishment delays and lead to a riparian planting with greater management options in the future.

Initial plant-to-plant densities for trees and shrubs will depend on their potential height at 20 years of age. Heights may be estimated based on: 1) performance of the individual species (or comparable species) in nearby areas on similar sites, or 2) predetermined and documented heights using Conservation Tree/Shrub Groups, Section II of the South Dakota eFOTG.

Plant Density Specification Are:

Plant Types and Heights	Plant to Plant Spacings (feet)
Shrubs less than 10 feet tall	3 to 6
Shrubs/trees 10-25 feet tall	5 to 8
Trees greater than 25 feet tall	8 to 14

As a guide to design density, consider that short shrubs planted at the maximum 6 by 6 foot spacing yields 1210 plants/acre. Taller shrubs and mid-sized trees planted at the maximum 8 by 8 foot spacing yields 680 plants/acre, whereas tall trees planted at 12 by 12 foot spacing yields 302 plants/acre, and tall trees planted at the maximum 14 by 14 foot spacing yields 222 plants /acre.

If Zones 1 and 2 of the riparian forest buffer are comprised of a combination of plant types, and include shrubs less than 10 feet tall, the initial planting goal shall be at least 500 plants/acre not including Zone 3. For other designs the initial planting density goal shall be 400 plants/acre not including Zone 3. For help in determining adequate stocking, consult the Riparian Forest Buffer Density worksheet to help design a riparian forest buffer with adequate initial stocking.

Riparian Forest Buffer - Tree/Soil Compatibility

Selection of locally native species will be a priority where feasible. Plantings will consist of two or more species with individual plants suited to the seasonal variation of soil moisture at the site. To determine which trees will grow satisfactorily on which soils and to determine the expected heights after 20 years, refer to the Conservation Tree/Shrub Groups in Section II, of the South Dakota eFOTG. Species that resprout will be used when establishing new rows nearest to streams or waterbodies subject to flooding or ice damage.

Woody Plant Stock

Plant types and species shall be selected based on their compatibility in growth characteristics and applicability to specific riparian functions and locations within the riparian zone. Species to meet a specific riparian function shall be selected from Woodland Technical Note No. 37 "Tree and Shrub Characteristics for Riparian or Specialty Plantings." Tree planting stock may vary depending upon the site and purpose of the planting. Once stock type has been determined refer to Woodland Technical Note No. 38 "Tree & Shrub Handling, Planting, and Care" page 2 for quality of planting stock to use. Use of native species is strongly encouraged. State-listed noxious weeds will be controlled and will not be part of the planting design.

Species diversity should be considered to avoid loss of function due to species-specific pests.

Woody phreatophytes (plants that obtain water by the penetration of their roots into the water table) and hydrophytes that deplete ground water should be used with caution in water-deficit areas

An adequate upstream or adjacent seed source must be present when using natural regeneration to establish a buffer. Follow the guidelines found on pages 5 and 10 of Woodland Technical Note No. 38 "Tree & Shrub Handling, Planting, and Care," when determining the practicality or methodology of using natural regeneration as an establishment method.

Stock Storage, Handling, and Care Requirements

To determine proper stock storage, handling and care requirements, refer to Woodland Technical Note No. 38 "Tree & Shrub Handling, Planting, and Care" pages 3 and 6.

Site Preparation

To determine an appropriate and sufficient method of site preparation, refer to Woodland Technical Note No. 38 "Tree & Shrub Handling, Planting, and Care," pages 3-6.

Planting Operation

To determine an appropriate planting technique for a particular stock used in a riparian forest buffer, and the proper time of year to plant, refer to Woodland Technical Note No. 38 "Tree & Shrub Handling, Planting, and Care," pages 7-10.

DESIGNS BY PURPOSE

To design better riparian forest buffers, knowledge of how they function is necessary.

Designs to Reduce Sediment, Excess Nutrients, Pesticides and Organic Material

Select species that are rapid growing and have an ability to absorb large amounts of nutrients from the ground water. Generally, species like cottonwood, hybrid poplars and willows grow fast in riparian areas. See Plant Density Specifications, page 5 of this document for plant to plant spacings. See Woodland Technical Note No. 37 "Tree and Shrub Characteristics for Riparian or Specialty Plantings" to determine which species are appropriate for this purpose.

Zone 2 will be expanded in high nutrient, or high sediment areas, or where an additional level of protection is desired.

Stiff-stemmed grasses established up-gradient of Zone 2 accelerate deposition of sediment. Where ephemeral, concentrated flow or sheet and rill erosion and sedimentation is a concern in the area up-gradient of Zone 2, a vegetated strip consisting of grasses and forbs, designated as Zone 3 shall be added to the riparian buffer. See Figure 5. Refer to the Filter Strip conservation practice standard (Code 393A) for guidance in establishing Zone 3.

When concentrated flow or excessive sheet and rill erosion and sedimentation cannot be controlled vegetatively, consider the addition of structural or mechanical treatments.

Weed control should be sufficient to ensure rapid establishment of the woody plants. Be alert to erosion potential if using tillage, especially in areas prone to flooding.

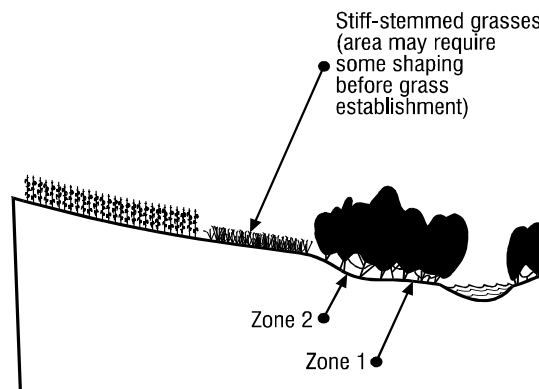


Figure 5. Sediment trapping above Zone 2

Generalized riparian forest buffer minimum widths necessary for sediment removal varies from 30 to 200 feet depending on individual site characteristics. Widths necessary for nutrient removal range from 15 to 300 feet.

Designs for Protection Against Scour Erosion

When establishing new rows nearest to watercourses or water bodies consider using species that readily re-sprout.

Avoid layouts and locations that would concentrate flood flows or return flows. Low, flexible-stemmed shrubs will minimize obstruction of local flood flows.

Designs to Create Shade to Lower Stream Temperatures

A buffer for lowering warm-season water temperatures shall consist of at least Zone 1 for watercourse reaches or water bodies less than or equal to 30 feet in width or water bodies greater than 30 feet wide but less than 1 acre. (Note: Buffers for wider water courses or larger water bodies may be valuable but will have only site-specific impacts on lowering water temperatures). Buffers shall be established or maintained on south and west sides of watercourses and bodies insofar as practical.

The buffer canopy shall be established to achieve at least 50 percent crown cover with average canopy heights equal to or greater than the width of the watercourse or 30 feet for water bodies. See Figure 6.

Buffer species shall include those with sufficient height potential. Place drooping or wide crowned trees and shrubs nearest the water courses or body. Shoreline or channel relief (e.g., deeply incised channels) and topographic shading will be taken into account in selecting species.

Generalized riparian forest buffer minimum widths necessary for water temperature moderation ranges from 60 to 100 feet depending on the individual site.

Designs to Provide a source of detritus and large woody debris for aquatic organisms

For purposes of providing detritus and large woody debris, riparian forest buffer management must maintain a minimum of 50 percent canopy cover.

Within Zone 1 as a minimum, establish, favor, or manage species capable of producing stems and limbs of sufficient size to provide an eventual source of large woody debris for in-stream habitat for fish and other aquatic organisms. To determine which species are effective sources of detritus, refer to Woodland Technical Note No. 37 "Tree and Shrub Characteristics for Riparian or Specialty Plantings." Where Zone 1 plants can be damaged by ice and flood flows, utilize species that sucker freely. If needed, these suckering plants may be interspersed with larger-growing species that are detritus sources.

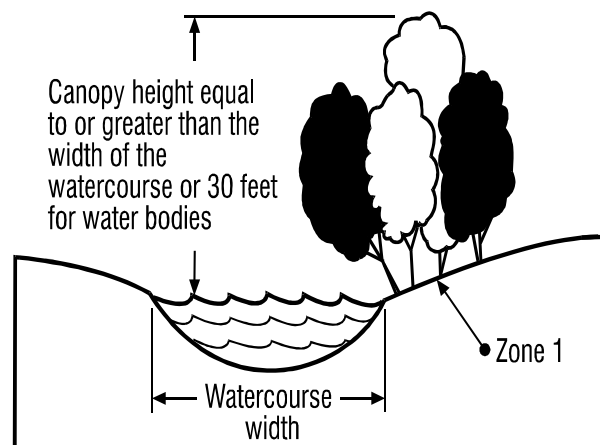


Figure 6. Canopy height for water temperature control.

Designs to create wildlife habitat

When the primary purpose of a riparian forest buffer is to improve conditions for wildlife, it is best to refer to the Wildlife Upland Habitat Management conservation practice standard (Code 645) in the South Dakota eFOTG for specific details appropriate for the wildlife specie(s) of interest. However, the design of riparian forest buffers for other purposes can be modified to make the practice more beneficial to wildlife while still addressing the original purpose of the planting. Considerations for improving the wildlife value of riparian forest buffers include, but are not limited to:

1. Provide dense areas (thickets) of suckering shrubs for winter thermal protection. For this purpose, suckering shrubs shall be planted at 5x5 or 6x6 foot spacing.
2. Choose a variety of plants that will provide food throughout the growing season, especially during mid and late winter. Refer to Woodland Technical Note No. 37 "Tree and Shrub Characteristics for Riparian or Specialty Plantings" for the value of individual species as a food source. Plantings shall consist of at least one food source that provides food from mid through late winter.
3. Retain 1-2 dead trees per acre as den trees and roost sites.
4. Connect isolated plantings together and provide travel corridors by extending riparian forest buffers along more of the stream reach or waterbody.
5. Consider the positive and negative impacts beaver, muskrat, deer, rabbits, and other local species may have on the successful management of the riparian and stream system. Temporary and local population control methods of these kinds of local species should be used cautiously and within state and local regulations.

Desired Widths For Selected Species of Wildlife (Total of both sides of a stream)

- 600 feet for bald eagles, cavity nesting ducks, heron rookeries, sandhill cranes
- 450 feet for common loons, pileated woodpeckers
- 300 feet for beaver, dabbling ducks, mink, salmonids
- 200 feet for deer
- 165 feet for lesser scaups, harlequin ducks
- 100 feet for salamanders, frogs

Designs for Forest Products

Favor tree and shrub species that are native and have multiple values such as those suited for timber, biomass, nuts, fruit, browse, nesting, aesthetics and tolerance to locally used herbicides. Select stocking rates within the range of those given on page 5 of this document. For most situations, subsequent thinning or pruning operations will be needed to maximize the value of the forest products produced. Refer to the conservation practice standard Tree/Shrub Pruning (Code 660A) for guidance on pruning. For guidance on thinning, refer to the conservation practice standard Forest Stand Improvement (Code 666).

Designs to Restore Riparian Plant Communities

Joining of existing and new buffers increases the continuity of cover and will further moderate water temperatures. A mix of species with growth forms that are tall and wide-crowned or drooping will increase moderation effects. For watercourses, buffers established on both sides will enhance multiple values.

Complex ownership patterns of riparian areas may require group planning for proper buffer design, function, and management.

The location, layout and density of the buffer should complement natural features.

Designs to increase Carbon Storage.

For maximum carbon storage select species that grow large, both above and below ground; have a long life span, and have the potential to develop usable material. Use a variety of species to minimize catastrophic losses. Maximum carbon storage is realized when the trees that capture the carbon are utilized in place of carbon-based fuels or are stored in a manner where the carbon will not be released through decomposition or combustion.

OPERATION AND MAINTENANCE

Competitive vegetation will be controlled for at least three years after planting. The Maintenance After Planting section, pages 10-14 in Woodland Technical Note No. 38 "Tree and Shrub, Handling, Planting, and Care" will be used to determine an appropriate form of weed control. To minimize erosion risks and to maximize riparian benefits, consider options that do not remove herbaceous vegetation from the entire area of the riparian planting. Utilize patch or strip weed control methods to maintain a four-foot wide weed free zone (two feet either side of the plant) around each plant.

Utilize mowing, herbicides or tillage to prevent invasion of aggressive sod-forming grasses and weeds until the tree canopies have closed.

Any tree or shrub that fails within the first couple of years should be replaced with a similar plant. Replants shall maintain the intended function of the planting and be compatible with soils and climate. After the second growing season at least 75 percent of all trees and shrubs planted should be alive to be considered a successful tree planting.

Where overland water flow may create a scour erosion hazard, orient the weed free Zones at an angle to the water flow. Perpendicular is most effective.

Felling and skidding of trees shall be directed away from the water course or water body. Skidding will be done in a manner to prevent creation of ephemeral channels perpendicular to the stream.

Successful establishment of a Riparian Forest Buffer may be hindered or threatened by activities of beaver, muskrat, mice, deer, rabbits or etc. Temporary and local population control may be necessary until the plants of the riparian forest buffer are large enough to withstand the wildlife pressure.

Water course crossings and livestock watering shall be located and sized to minimize impact to buffer vegetation and function. On established buffers included within grazed areas, set utilization rates of key woody browse to allow woody vegetation to regrow sufficiently for its intended function. Impairment of buffer function by livestock overuse (trampling, compaction or over-utilization of woody plants) shall require immediate removal of livestock from the riparian area.

REQUIRED DOCUMENTATION

The location of the buffer shall be marked on a conservation plan map or aerial photo, and as a scaled sketch on the SD-CPA-6 Specification Form or Job Sheet.

A completed SD-CPA-6 Specification Form, or Riparian Forest Buffer Conservation Practice Job Sheet.